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Analysis of Thermal Stress and Metal Movement During Welding

An important problem in the fabrication of large aluminum-alloy structures is the control of distortion caused by welding. Frequently, components of such structures must be fabricated to close dimensional tolerances, such as in aerospace applications. Unacceptable distortion that occurs during the welding of joints in these structures often cannot be corrected without removal of the joint. Distortion can also cause mismatching of weld joints which result in the reduction of joint strength.

The present production practices have treated distortion with empirical solutions to individual problems. However, little has been known about the mechanisms causing such distortions. As a result, a study was performed with the following objectives:

1. An investigation of temperature changes caused by the welding arc, which includes an analysis of temperature distribution due to the heat generated by the welding arc;
2. The development of a system of mathematical statements describing the phenomenon of thermal stresses and plastic strains during welding; and
3. The development of a system of mathematical solutions and computer programs for one-dimensional analysis.

Results of this study are published in a report which

also includes a brief technical background of the analysis and control of weld distortion. In addition, the report develops a computer program that describes the longitudinal stress obtained after a welding operation.

Notes:

1. A comparison of analytic results with experimental data is in progress. The data are being obtained from several welds under various conditions using a 1/4-inch (6.4 mm) aluminum plate.
2. Additional documentation may be obtained from:
Technology Utilization Officer
Marshall Space Flight Center
Code A & TS-TU
Huntsville, Alabama 35812
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Patent status:

No patent action is contemplated by NASA.

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